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IS : 3118 - 1978
(Reaffirmed 2001)

Indian Standard
SPECIFICATION FOR
ELECTRIC BACTERIOLOGICAL INCUBATORS
(*First Revision*)

UDC 616.083.92 : 576.8.093.3



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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Price Rs. 6.00

G-3

April 1979

Indian Standard

SPECIFICATION FOR ELECTRIC BACTERIOLOGICAL INCUBATORS (*First Revision*)

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Indian Standard
SPECIFICATION FOR
ELECTRIC BACTERIOLOGICAL INCUBATORS
(*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 21 November 1978, after the draft finalized by the Hospital Equipment Sectional Committee had been approved by the Consumer Products and Medical Instruments Division Council.

0.2 Formulation of standards on hospital equipment has been taken up on the recommendations of the Advisory Committee for the Development of Surgical Instruments, Equipment and Appliances of the then Ministry of Industry and Supply, Government of India.

0.3 This standard was first published in 1965 and now it has been revised keeping in view the latest developments in the manufacture of electric bacteriological incubators. In this revision, performance test for thermostats used has been included and the insulation resistance test has been modified.

0.4 This standard covers the general, performance and safety requirements for electrically heated incubators mainly used in laboratories for bacteriological and allied work, with a view to ensuring reliable operation, personal safety against electric shock, heat and fire. Dimensions of components parts have not been specified. It is recognized that some parts of incubators may have to be replaced during use. For this reason, it is essential that the manufacturers should so design their incubators that the spare parts of any particular size are interchangeable within one's manufacture.

0.5 Adequate provisions have been made throughout, the standard for safety and satisfactory design of the apparatus, bearing in mind the fact that a good deal of latitude is to be allowed to the individual manufacturer of incubators to introduce innovations and refinements.

0.6 ' General and safety requirements for household and similar electrical appliances (*fourth revision*) ' (IS : 302-1973) to which references have been

made in this standard with regard to general and safety requirements as well as methods of tests is a necessary adjunct to this standard. Should, however, any deviations exist between the requirements of IS: 302-1973 and those of this standard, provisions of the latter shall apply.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down the requirements and performance tests of electrically heated incubators used in the laboratories for bacteriological and allied work (*see* 2.1), designed for thermostatic control at one or more temperatures above ambient and up to 80°C, and for connections to supplies at 240 V ac single-phase 50 c/s, or dc 230 or 240 V systems, with rated loading not exceeding 3 kW.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Incubators — A closed chamber designed and constructed for cultivation of bacteria or for facilitating biological tests with or without arrangements for humidifying the air or supply of oxygen.

2.1.1 Gravity Convection Incubator — An incubator in which heat transfer within the working space takes place predominantly through convection currents of air caused by difference of density of air at different temperatures.

2.1.2 Forced Convection Incubator — An incubator in which heat transfer within the working space takes place predominantly through air currents forced by a circulating fan.

2.1.3 Water-Jacketed Incubator — An incubator which is enclosed in and heated through a water jacket.

2.1.4 Fixed Temperature Incubator — An incubator which is designed to operate at a fixed temperature, though its temperature may be capable of being adjusted within narrow limits, not exceeding plus or minus 5 degrees Celsius.

*Rules for rounding off numerical values (*revised*).

2.1.5 Wide Range Incubator — An incubator designed to operate at any set temperature above ambient in a wide range exceeding 10 degrees Celsius. The temperature being set by adjustment of the thermostat.

2.2 Working Space — The space within the incubator which is above the lowest shelf and not less than 5 cm from any heating surface or 3 cm from any non-heating surface of any wall or roof.

2.3 Incubator Temperature — The mean of the maximum and minimum temperatures of the air recorded at the centre of the working space over one complete cycle of the thermostat.

2.4 Temperature Variation — The difference in the temperature of air at the centre of the working space and at any other point in the working space at any instant.

2.5 Temperature Differential — The cyclic change of temperature at any point regulated by the operation of the thermostat.

2.6 Temperature Drift — The change in incubator temperature which may take place in continuous operation over a long period.

2.7 Temperature Overshoot — The amount by which the maximum temperature attained by air at the centre of the working space during the initial heating-up exceeds the incubator temperature when steady operating condition of the thermostat is reached.

3. RATING

3.1 Voltage Rating — The highest rated voltage shall be as follows:

- a) For ac, 240 V
- b) For dc, 230 V or 240 V

4. MATERIAL

4.1 The provisions of 5.1 of IS : 302-1973* shall apply.

5. CONSTRUCTION

5.1 The relevant provisions of 7 of IS : 302-1973* and those given in 5.2 to 5.6 shall apply.

*General and safety requirements for household and similar electrical appliances (*fourth revision*).

5.2 Cabinet

5.2.1 The inner surface of the cabinet and its fittings shall be smooth and impervious, and resistant to corrosion.

5.2.2 The cabinet with the doors closed shall be lightproof. In addition to the outer lightproof door, an inner door with a clear glass panel shall be provided for viewing the interior. All doors shall be fitted with suitable gaskets or packing for tight closure.

5.2.3 Ventilation of the cabinet shall be provided by means of one or more ports at the bottom and the top of the cabinet. In large cabinets circulating fans may be provided to assist convection and ventilation, so that temperature variation is minimized. The ports at the top of the cabinet shall be adjustable to regulate ventilation rate.

5.2.4 The glass panels used shall be capable of withstanding continuously the maximum temperature at which the incubator is designed to operate.

5.2.5 Shelves shall be made of stout wire mesh, expanded metal or perforated sheet metal, treated to resist corrosion. The design of lugs, brackets or runners for shelves shall be such that heavily laden shelves do not tilt during withdrawal.

5.3 Water Jacket

5.3.1 When a water jacket is provided, it shall be made of copper or other material not inferior to copper in resistance to corrosion under normal working conditions.

5.3.2 The water jacket shall have a drain cock or plug, a water level gauge and an opening for filling.

5.3.3 All seams and joints shall be secured by welding, brazing or soldering. If soft solder is used, the solder shall not be depended upon for mechanical strength, which shall be assured by welding, riveting or lock-jointing.

5.4 Heating Element — The heating element shall be so designed and located that overheating in its vicinity is minimized. The heating element or that part of it which is fixed on the inside bottom of the incubator shall be covered by suitable baffles or perforated covers so that fresh air entering through the bottom ports is preheated and uniformly distributed in the working space, and undue heating of the bottom shelves is avoided.

5.4.1 If trays are provided for maintaining a high humidity by evaporation of water in them, the heating element shall be protected from accidental spillage of water.

5.5 Thermostat

5.5.1 The thermostat contacts and the contacts of any auxiliary device such as relays or contactors shall be readily accessible for inspection, cleaning or replacement, by the removal of a simple cover retained by one or more screws.

5.5.2 The thermostat contacts shall be of silver, platinum, or other material which will not be easily fouled or welded by arcing.

5.5.3 If a mercury switch is used in a thermostat or in an auxiliary device, it shall be securely mounted and protected so that it cannot be damaged easily in normal handling or transport of the incubator.

5.5.4 If the thermostat contacts are slow acting, a condenser of sufficient capacity shall be connected across them to prevent excessive arcing and to minimize radio interference.

5.5.5 If the stem, bulb, or other sensing part of the thermostat is fixed in or protrudes into the working space, it shall be adequately protected from accidental damage during loading or unloading of the incubator.

5.5.6 If the thermostat adjusting screw, knob or other adjusting mechanism is exposed to unintentional or accidental disturbance of setting, a scale shall be provided for checking the setting.

5.6 Thermometer — The thermometer, when provided, shall be capable of reading temperatures with an accuracy of at least 0.5°C . Arrangement shall be provided for fixing such a thermometer on the cabinet so that its sensing element is at least 5 cm below the top of the inner chamber.

Note — Thermometers are generally marked in red lines at 37°C and 56°C marking.

6. GENERAL AND SAFETY REQUIREMENTS

6.1 Protection Against Electric Shock — The provisions of 8 of IS : 302-1973* shall apply.

6.2 Electric Insulation — The provisions of 11 and 44 of IS : 302-1973* shall apply.

6.3 Stability — The provisions of 14 of IS : 302-1973* shall apply.

6.4 Mechanical Strength — The provisions of 15 of IS : 302-1973* shall apply.

6.5 Supply Connections — The provisions of 20 of IS : 302-1973* shall apply.

*General and safety requirements for household and similar electrical appliances (*fourth revision*).

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6.6 Terminals — The provisions of 21 of IS : 302-1973* shall apply.

6.7 Earthing — The provisions of 22 of IS : 302-1973* shall apply.

6.8 Screws and Connections — The provisions of 23 of IS : 302-1973* shall apply.

6.9 Resistance to Rusting — The provisions of 37 of IS : 302-1973* shall apply.

7. PERFORMANCE REQUIREMENTS

7.1 Heating-Up Time — The incubator when switched on without loading at ambient temperature shall take not more than 45 minutes to attain the maximum temperature attainable by it.

7.2 Temperature Variation — The incubator shall satisfactorily pass the tests specified in 9.2.4 to 9.2.8.

8. MARKING AND INSTRUCTIONS FOR USE

8.1 Each incubator shall be marked indelibly and clearly in accordance with 25 of IS : 302-1973* on its outer surface or on a name plate firmly attached to it.

8.1.1 The marking shall also show the minimum ambient temperature at which the incubator is suitable for operation.

8.1.2 The incubators may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

8.2 Marking of Earth Terminal — The symbol ' \perp ' shall be marked permanently on or adjacent to the earth terminal, if provided.

8.3 Instructions for Use — Each incubator shall be provided with necessary instructions including precautions to be taken for its proper use, maintenance and resetting. The instruction leaflet or manual shall include a recommended list of spare parts.

*General and safety requirements for household and similar electrical appliances (*fourth revision*).

9. TESTS

9.1 General Conditions for Tests

9.1.1 Test Voltage — The tests shall be carried out either at the rated voltage or at the maximum voltage of the range unless otherwise specified in the relevant clauses. The test voltage shall not vary by more than ± 10 percent during the test.

9.1.2 Ambient Temperature — The ambient temperature during the performance test shall be $27 \pm 2^\circ\text{C}$.

9.1.3 Test Temperatures — The temperature variation test and temperature differential test shall be carried out at the fixed operating temperature in the case of fixed temperature incubators, or at 5°C above the ambient and again at 5°C below the maximum of the range in the case of wide range incubators. The temperature drift test, the temperature overshoot test, and the reproducibility of temperature test shall be done at the fixed operating temperature of a fixed temperature incubator or at the midpoint of the temperature range of a wide range incubator.

9.1.4 Measurement of Temperatures — The measurements of temperatures for the purpose of the temperature variation and temperature differential tests shall commence two hours after the incubator is switched on or one hour after the final adjustment of thermostat, whichever is later.

9.1.4.1 The incubator temperature, temperature drift and temperature overshoot shall be measured with a long stem thermometer of the mercury-inglass type, with the bulb as near as possible to the centre of the working space. The thermometer shall have a bulb capacity not greater than 0.5 ml, a maximum error not over 1°C and the error over any interval of 10°C shall not vary by more than 1°C . It shall also be permissible to use a thermocouple, thermistor or other compact sensing element with a suitable indicator provided its response to temperature changes and its accuracy are not inferior to the thermometer described.

9.1.4.2 The temperature variation and temperature differential shall be measured with thermocouples, thermistors, or other compact temperature sensing elements capable of measuring temperature differences of 0.2°C in the temperature range of the incubator. For the purpose of measurements, one sensing element shall be placed as near as possible to the centre of the working space and the others successively at the following points:

- a) Each of the four upper corners of the working space,
- b) Each of the four centres of the four sides of the working space, and
- c) Each of the four points vertically above the four lower corners of the working space and 2 cm above the lowest shelf.

In the case of cylindrical incubators the above twelve points shall be substituted by ten points equally distributed on the cylindrical periphery of the working space and two points on the axis of the cylinder, one at each end.

9.1.5 Arrangement of the Incubator — The incubator shall be tested on a table or stand one metre above floor level and located so as to be protected from direct sun rays or draughts, when carrying out the performance tests. It shall have all the shelves in position but not loaded, and the top ventilation ports shall be adjusted according to the manufacturers' instructions. In the case of a water jacketed incubator, water must be initially filled up to and later maintained at the level recommended by the manufacturer.

9.2 Schedule of Tests — Schedule of tests to be carried out on the incubators for proving conformity with the requirements of this standard is given in Table 1 with suitable reference to relevant clauses of IS : 302-1973* and this standard.

9.2.1 Visual Examination and Inspection — Each incubator shall be examined and inspected for general construction and marking requirements specified in this standard.

TABLE 1 SCHEDULE OF TESTS
(Clause 9.2)

TEST	METHOD
<i>Routine Test</i>	
Visual examination and inspection	9.2.1
Protection against electric shock	40 of IS : 302-1973*
High voltage	42.3 of IS : 302-1973*
Insulation resistance	11 and 44 of IS : 302-1973* and 9.2.2
Leakage current	44 of IS : 302-1973*
Earthing connection	38 of IS : 302-1973*
<i>Type Test</i>	
Mechanical strength	36 of IS : 302-1973*
Performance test for thermostats	49 of IS : 302-1973* and 9.2.3
Temperature variation test	9.2.4
Temperature differential test	9.2.5
Temperature drift test	9.2.6
Test for reproducibility of temperature setting	9.2.7
Temperature overshoot test	9.2.8

*General and safety requirements for household and similar electrical appliances (fourth revision).

*General and safety requirements for household and similar electrical appliances (fourth revision).

9.2.2 Insulation Resistance Test — While conducting this test in accordance with 11 and 44 of IS : 302-1973*, the appliance shall not be subjected to humidity.

9.2.3 From lot of thermostats for use in the incubators, three samples shall be subjected to the performance test as described in 49 of IS : 302-1973*.

9.2.4 Temperature Variation Test — With the temperature sensing elements located as described in 9.1.4.2, the temperature differences shall be read with reference to the sensing element located at the centre of the working space. For this purpose, the other sensing elements may be connected differentially with the sensing element at the centre. The temperature variation at each point shall be determined by taking the mean of at least three readings of temperature difference at that point. The maximum temperature variation between any two points tested shall not exceed 1.5°C .

9.2.5 Temperature Differential Test — With a temperature sensing element located successively at all the different points described in 9.1.4.2, or a number of sensing elements located simultaneously at all the points described, the temperature at each point shall be recorded continuously or at intervals not exceeding 5 minutes during a three-hour test period. The temperature differential measured at any point shall not exceed 1°C .

9.2.6 Temperature Drift Test — With the incubator adjusted as required in 9.1.3, the incubator temperature shall be recorded once every 8 hours with the thermometer described in 9.1.4.1, for a continuous period of 72 hours. The temperature drift so measured shall not exceed 1.5°C .

9.2.7 Test for Reproducibility of Temperature Setting — At the end of the test as described in 9.2.6, when the last temperature reading has been taken, the incubator shall be switched off but left otherwise undisturbed for 24 hours. At the end of this period the incubator shall be switched on again for at least 3 hours without altering the thermostat setting. At the end of this period the original temperature before switching off shall be regained to within 0.5°C .

9.2.8 Temperature Overshoot Test — In the above test during the initial heating up, the temperature shall be recorded at least every 5 minutes when the temperature approaches the original temperature in the test according to 9.2.7 with 3°C , until a steady temperature is reached again. The maximum temperature recorded shall not exceed the steady incubator temperature finally obtained by more than 1°C .

*General and safety requirements for household and similar electrical appliances (fourth revision).

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	CONVERSION
Force	newton	N	1 N = 0.101 972 kgf
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

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Printed at Neelkamal Printers, Delhi, India